Programming Education under Implementation of the New Course of Study from 2020

Department of Education, Bukkyo University　Fumiaki FURUICHI

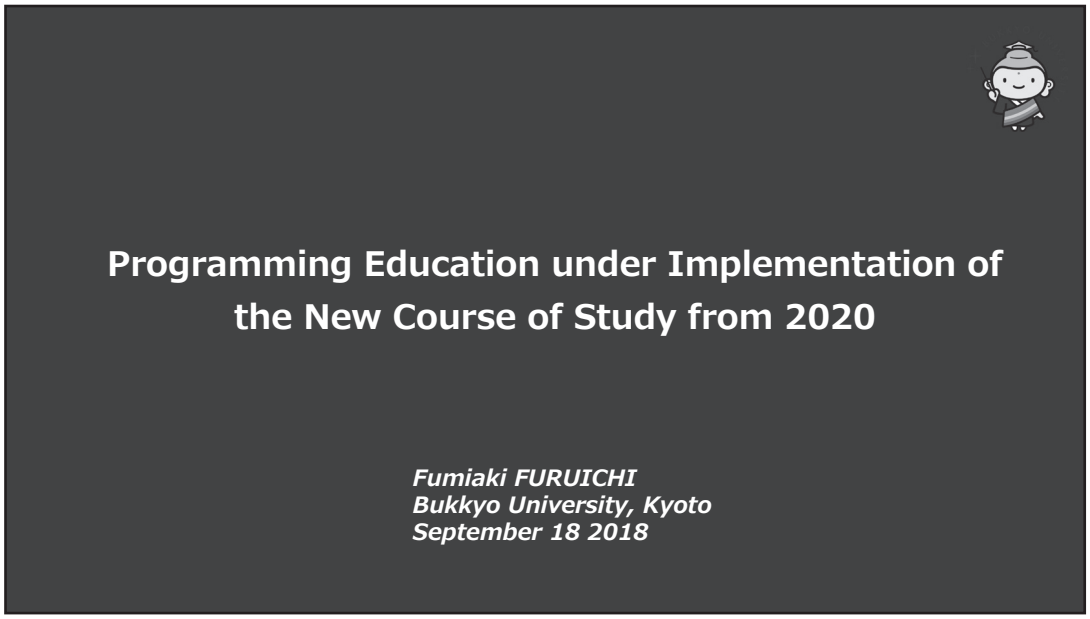
Abstract

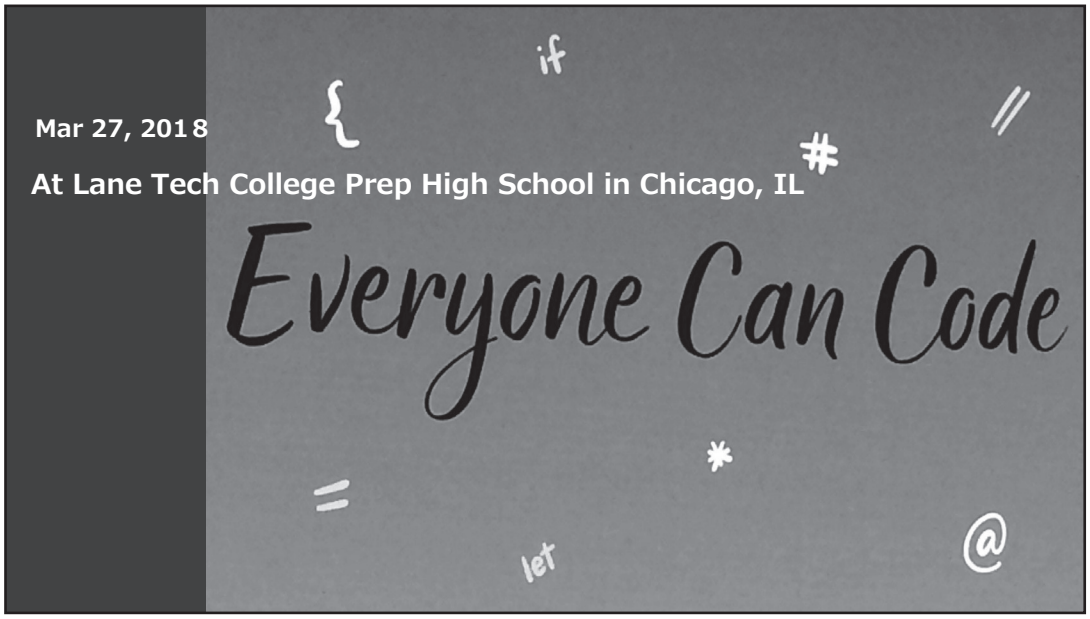
In recent years, interest in IT-related education, including programming education at the elementary school and junior high school levels, has been rising globally. In Japan, "programming education" will be introduced in 2020. Yet no initiatives at schools to develop teaching methods in programming education seem to be underway. Given this situation, I would propose that the educational administration and teacher training universities cooperate in developing and promptly implementing instructor training programs for in-service teachers.

We have also found that students aspiring to be teachers do not mind learning teaching methods in programming education. It is among our duties to equip these young teacher candidates with essential skills in programming education and train them to become potential leaders in this area at schools when they start teaching.

It has been predicted that a "technological singularity" will occur around 2045, when the artificial intelligence will surpass human intelligence. In view of this, the government and industries have already started various actions toward "Society 5.0." The new Courses of Study, which aiming to introduce STEAM education, have specified the introduction of "computational thinking". Those of us in the field of education should not lag behind, either.

In my own experience, during a workshop at my university, students of the digital-native generation did not have much difficulty completing the practice shown here and then further proceeding to advanced problems.


Programming Education under Implementation of the New Course of Study from 2020
Fumiaki FURUICHI
Bukkyo University, Kyoto
September 18 2018


Mar 27, 2018
At Lane Tech College Prep High School in Chicago, IL
Everyone Can Code
if
let

From Now on, Our Future is Society 5.0.

Government public relations office　Society5.0　https://www.govonline.go.jp/cam/s5/#sectionMovie

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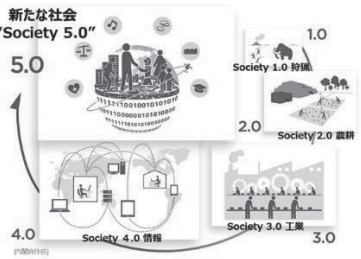
From Now on, Our Future Is Society 5.0.



Cabinet Office **Society 5.0**
http://www8.cao.go.jp/cstp/society5_0/index.html

Industrial Competitiveness Council　May 19, 2016https://japan.kantei.go.jp/97_abe/actions/201605/19article8.html

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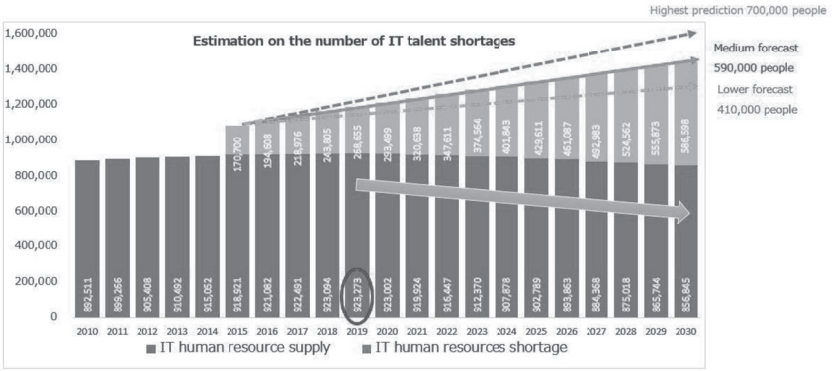
From Now on, Our Future Is Society 5.0.



Survey results on latest trends and future estimates of IT personnel
2018/06/10 Ministry of Economy, Trade and Industry (Author reorganization)

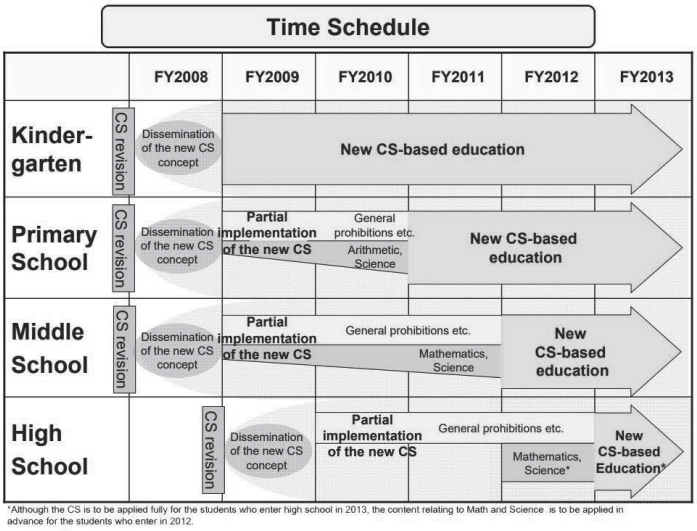
5

700,000

The highest prediction is a big number, isn't it?

6

The Schedule for Publishing The New Courses of Study



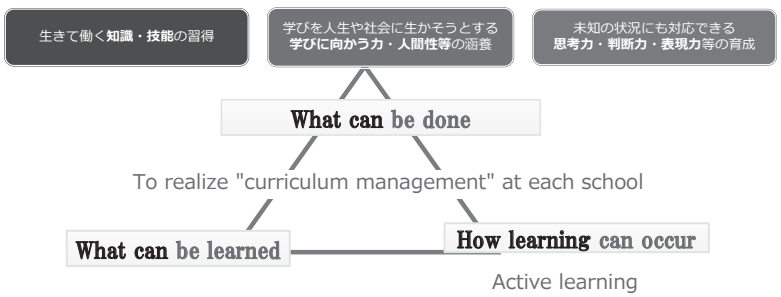
*Although the CS is to be applied fully for the students who enter high school in 2013, the content relating to Math and Science is to be applied in advance for the students who enter in 2012.

http://www.mext.go.jp/en/policy/education/elsec/title02/detail02/__icsFiles/afieldfile/2011/03/28/1303755_001.pdf

7

The Policy on the New Course of Study

Fostering the qualities and abilities required for a new era



MEXT-HP http://www.mext.go.jp/a_menu/shotou/new-cs/__icsFiles/afieldfile/2017/09/28/1396716_1.pdf
(Author reorganization)

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Overview of New Course of Study (Arithmetic)

Elementary School General Provisions p.83

(3)　In each school, information tools such as computers, information communication networks, etc., as well as the environment necessary for and effective use of these are prepared and aimed to enrich the learning environments that can appropriately be utilized.

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Elementary School **New COURSES OF STUDY**
Chapter 1 General Provisions

2. In addition to the above, consideration should be given to the following items:

When teaching subjects, etc., each school should improve learning activities so that pupils become familiar with information devices, such as computers and information and communications networks, acquire basic operation skills,

such as typing letters on a computer keyboard,

and information ethics, and are able to use information devices appropriately. In addition to these information devices, each school should also use other teaching materials and aids properly, such as audiovisual materials and teaching and learning devices.

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From Now on, "Programming Education" begins.

Items	Select Designated School	Implemented under the leadership of educational administration	Implemented at the teacher training center	Have a company assist
Prefectures/47	10	14	29	7
Designated cities/20	7	4	8	2
Undecided/67	50	49	30	58

the material at the section managers meeting of Prefectural Board of Education at May 2018
(Author's creation)

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Elementary School **New COURSES OF STUDY**
Chapter 1 General Provisions

校種	キーボード文字入力数	対象	調査期間
Elementary school	5.9 characters/minute	5th grade (116 schools; n = 3,343)	2013.10 to 2014.01
Junior high school	15.6 characters/minute	2nd grade (104 schools; n = 3,338)	2013.10 to 2014.01
High school	24.7 characters/minute	2nd grade (n = 4,552)	2015.12 to 2016.03

MEXT –the survey of information literacy http://jouhouka.mext.go.jp/school/joukatu/index.html

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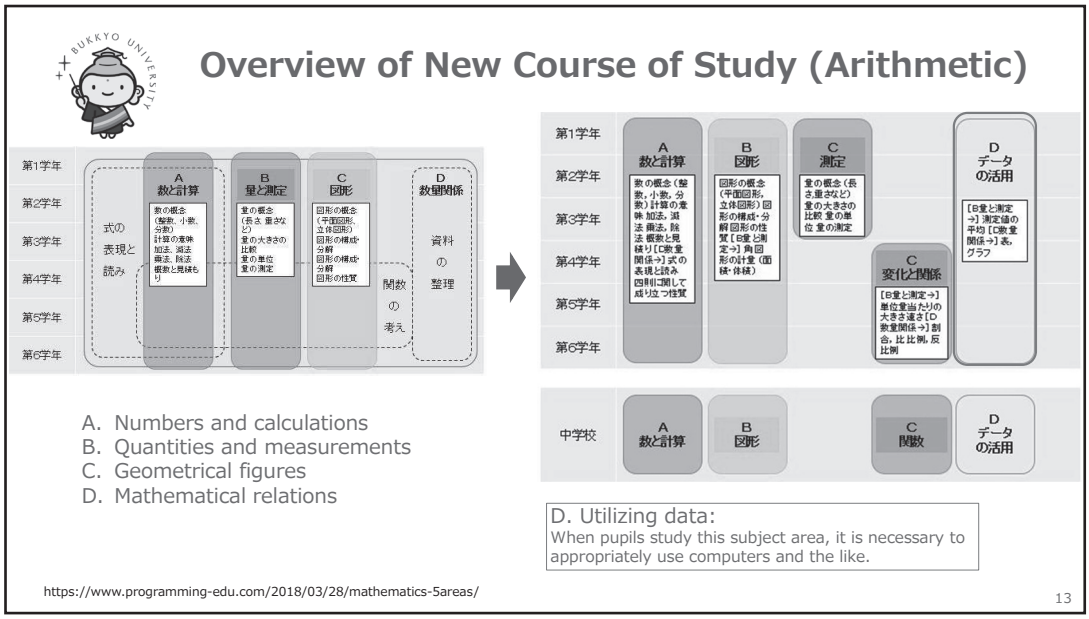
Overview of New Course of Study (Arithmetic)
第1学年
第2学年
第3学年
第4学年
第5学年
第6学年
式の表現と読み
A 数と計算
数の概念（整数，小数，分数）計算の意味 加法，減法 乗法，除法 概数と見積もり
B 量と測定
量の概念（長さ 重さなど）量の大きさの比較 量の単位 量の測定
C 図形
図形の概念（平面図形，立体図形）図形の構成・分解 図形の性質
関数の考え
D 数量関係
資料の整理
A 数と計算
数の概念（整数，小数，分数）計算の意味 加法，減法 乗法，除法 概数と見積もり【C数量関係→】式の表現と読み 四則に関して成り立つ性質
B 図形
図形の概念（平面図形，立体図形）図形の構成・分解 図形の性質【B量と測定→】角 図形の計量（面積・体積）
C 測定
量の概念（長さ，重さなど）量の大きさの比較 量の単位 量の測定
C 変化と関係
【B量と測定→】単位量当たりの大きさ 速さ【D数量関係→】割合，比 比例，反比例
D データの活用
【B量と測定→】測定値の平均【数量関係→】表，グラフ
中学校
A 数と計算
B 図形
C 関数
D データの活用
A. Numbers and calculations
B. Quantities and measurements
C. Geometrical figures
D. Mathematical relations
D. Utilizing data:
When pupils study this subject area, it is necessary to appropriately use computers and the like.
https://www.programming-edu.com/2018/03/28/mathematics-5areas/
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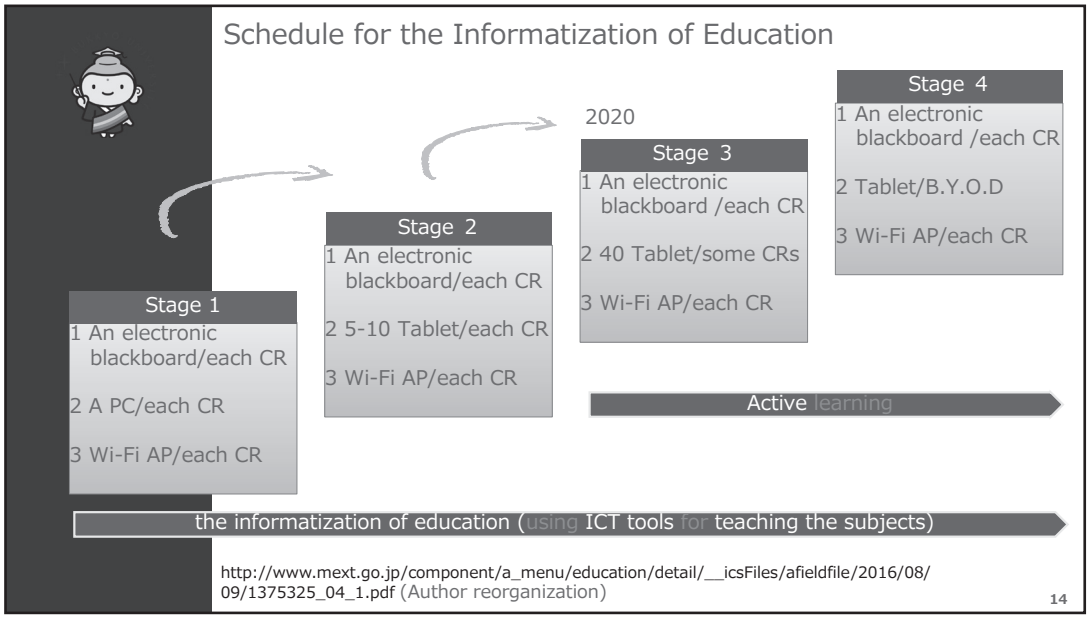
Schedule for the Informatization of Education
Stage 1
1 An electronic blackboard/each CR
2 A PC/each CR
3 Wi-Fi AP/each CR
Stage 2
1 An electronic blackboard/each CR
2 5-10 Tablet/each CR
3 Wi-Fi AP/each CR
2020
Stage 3
1 An electronic blackboard /each CR
2 40 Tablet/some CRs
3 Wi-Fi AP/each CR
Stage 4
1 An electronic blackboard /each CR
2 Tablet/B.Y.O.D
3 Wi-Fi AP/each CR
Active learning
the informatization of education (using ICT tools for teaching the subjects)
http://www.mext.go.jp/component/a_menu/education/detail/__icsFiles/afieldfile/2016/08/09/1375325_04_1.pdf (Author reorganization)
14

Innovation Changes Society: Technology Will Change the Structure of Industry.

Society 4.0 Technology has developed rapidly.

65%

65 percent of today's grade-school children may end up doing work that hasn't been invented yet.

Professor Cathy N. Davidson, City University of New York

47%

47% of jobs are at risk of becoming automated.

Michael A. Osborne, Oxford University

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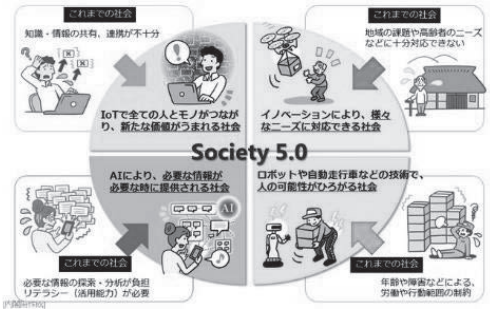
Innovation Changes Society: Technology Will Change the Structure of Industry.

Society 5.0

Big data
+
AI technology
+
The forefront of biotechnology



Well-being Society

The solution to resolve the problems that contemporary society is facing, such as the population problem, the food problem, the resource energy problem, the aging of society, etc.

Cabinet Office http://www8.cao.go.jp/cstp/society5_0/index.html (Author reorganization)

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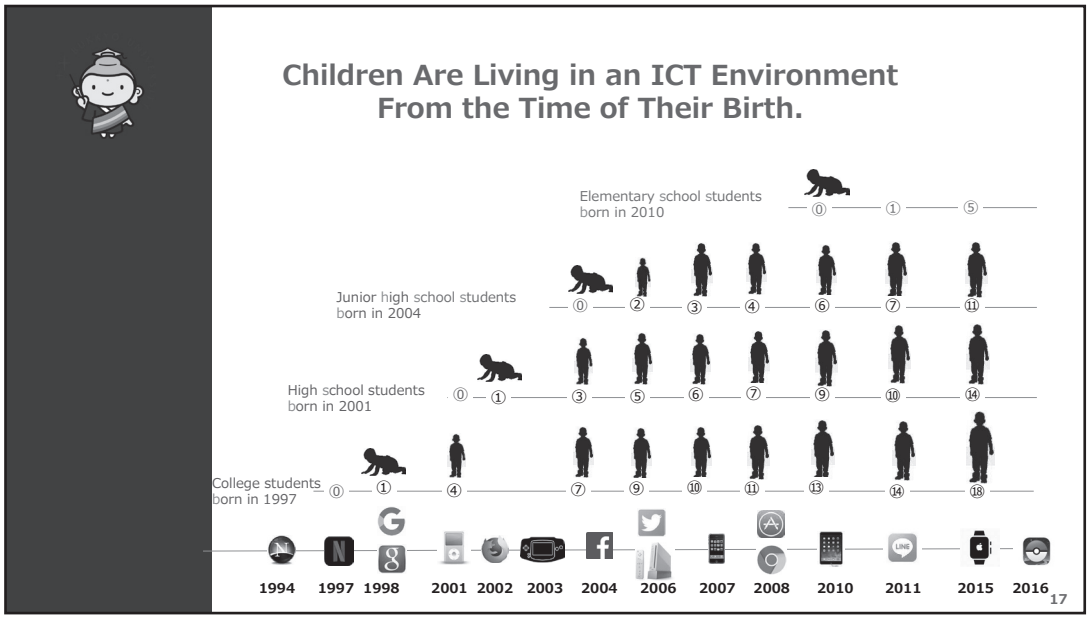
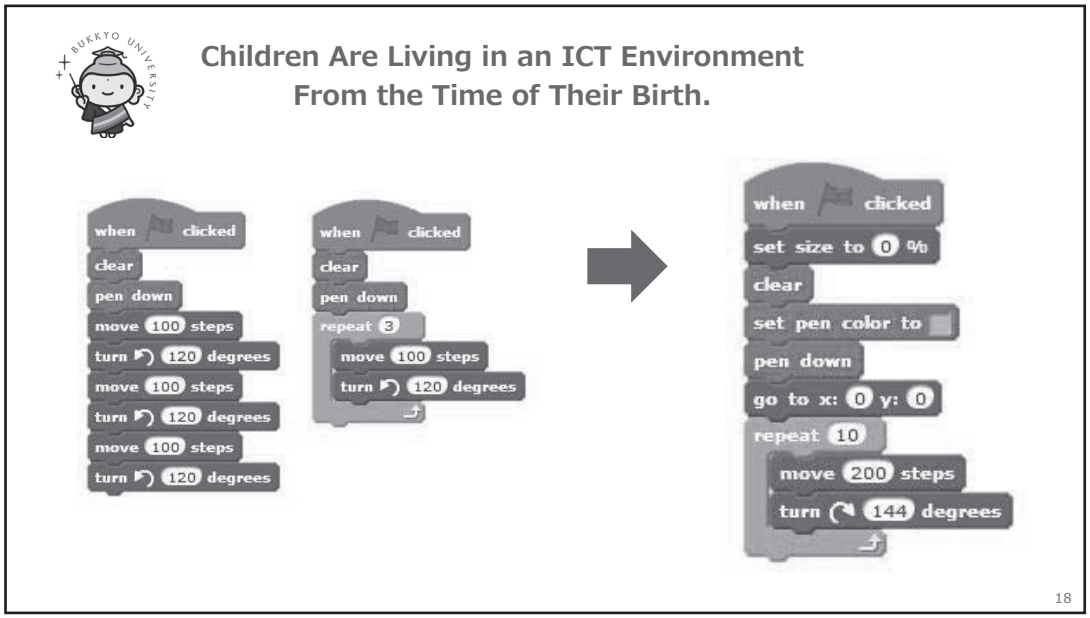
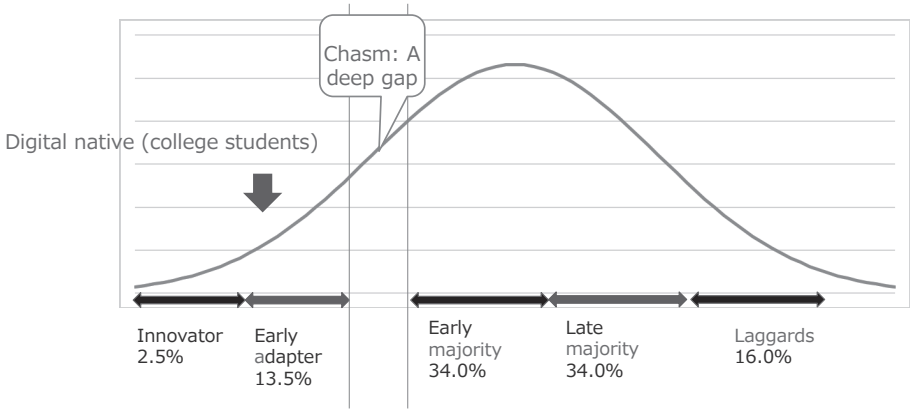

Children Are Living in an ICT Environment
From the Time of Their Birth.
Elementary school students
born in 2010
Junior high school students
born in 2004
High school students
born in 2001
College students
born in 1997
1994
1997
1998
2001
2002
2003
2004
2006
2007
2008
2010
2011
2015
2016
17


Children Are Living in an ICT Environment
From the Time of Their Birth.
when clicked
clear
pen down
move 100 steps
turn 120 degrees
move 100 steps
turn 120 degrees
move 100 steps
turn 120 degrees
when clicked
clear
pen down
repeat 3
move 100 steps
turn 120 degrees
when clicked
set size to 0 %
clear
set pen color to
pen down
go to x: 0 y: 0
repeat 10
move 200 steps
turn 144 degrees
18

Direction of Programming Education in Japan

The innovators are the college students.



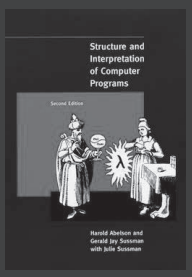
マーケティング・コンサルタントのジェフリー・A・ムーア（Geoffrey A. Moore）が『Crossing the chasm』（日本語訳『キャズム』）で提唱した理論

19

To mention the qualities necessary for the qualities necessary for the AI era here ...

Logic expressions (programs) for AI must be written for people to read, and surely incidentally for AI to understand.

Programs must be written for people to read, and only incidentally for machines to execute.



Published by Massachusetts Institute of Technology (MIT)
Classical textbook "*Structure and Interpretation of Computer Programs*" used in programming introductory lecture at many universities, including MIT

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（ふるいち　ふみあき　佛教大学教育学部）